NOTES ON SOME PROBLEMS OF ADAPTATION: 4. THE PHOTIC SENSITIVITY OF OGILBIA.[1]

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Parker ('09) has commented upon the curious fact that although so primitive a chordate as ammocœtes exhibits a well-defined integumentary sensitivity toward light, marine fishes as a class seem devoid of this type of irritability, which is also absent in *Amphioxus* (Parker, '08; Crozier, '17). Recently Jordan ('17) has described the first recognized instance of photic sensitivity resident in the skin of a marine teleost, the hamlet (*Epinephelus striatus*). I wish now to record a second example of this type of sensitivity in a marine fish, *Ogilbia* (*Brosmophycis*) *verrillii* Garman.

The case of *Ogilbia* is of peculiar interest. The Brotulidæ, to which group *Ogilbia* belongs, are for the most part deep water fishes, but include several forms occurring in warm shallow situations on the Pacific and on the Atlantic shores of America. They seem to represent the ancestral type from which may be traced the evolution of the blind brotulids of the Cuban caves (Eigenmann, '09). The behavior of *Ogilbia*, concerning which very little has been known, should in consequence be a source of important information bearing upon the derivation of the related cave forms.

Ogilbia verrillii (Garman, '00) was first collected at Bermuda by Verrill. According to Eigenmann ('09, p. 187)—who, curi-

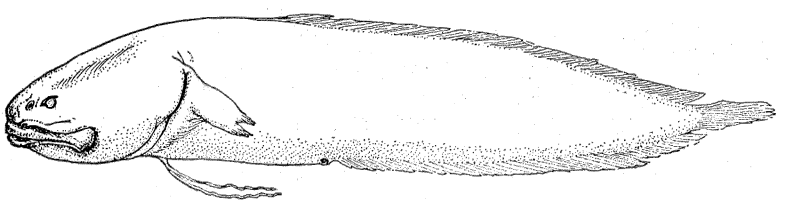

FIG. 1. *Ogilbia verrillii* Garm. (× 2⅓). Note the relatively minute eye.

[1] Contributions from the Bermuda Biological Station for Research, No. 130.

ously enough, in his review fails to mention the significant occurrence of *Ogilbia* at Bermuda—other species occur (*O. ventralis*) "in rocky pools about the Gulf of California and at La Paz," and (*Brosmophycis cayorum*) "on a shoal covered with algæ at Key West." My own specimens of *O. verrillii*, obtained singly and at scattered intervals, were secured from widely separated points about Bermuda—along the shore of Flatts Inlet, on the north side of Dyer Island, in Fairyland Creek, and in Tucker's Town Bay. In each case the habitat was at about low water level, either under a rock of some size or else in a dense mass of reddish and brown algæ. The length of these individuals was not over 4.5 cms. In color they were brownish yellow, speckled with minute red dots; there was little indication of counter-shading. They are not vigorous swimmers. When exposed to bright sunlight, by the sudden overturning of a rock slab, they seemed stupefied, and in several instances were easily secured by hand.

I wished to examine the behavior of these fishes toward light, and although but six specimens were available for experimentation, at different times from April, 1916, to December, 1917, the observations made seem adequate for certain purposes.

These fishes were intensely reactive to sunlight. If placed in an aquarium with one end illuminated from above, they remained almost stationary in the shaded portion, and if caused to swim toward the lighted area they turned back almost instantly when the anterior end came into the light. With direct sunlight, temperature 26° C., the reaction time averaged 1.3 seconds. Rheotactic response was also well marked, the animals heading in the usual way into a current. Taking advantage of this response, by appropriately directing a mild stream of water into a circular dish, it was possible to induce swimming movements without touching the fish.

Stimulated in this way, an *Ogilbia* would swim slowly up to the edge of a sharply defined sunbeam and remain stationary in the shade. Comparatively violent, undirected, swimming could be induced by suddenly illuminating the whole dish. Swimming movements ceased almost immediately when the light was

obstructed. *Ogilbia* is very strongly thigmotactic and in most cases settled in the angle between the bottom and the wall of an aquarium.

With two specimens it was possible to remove the eyes and to keep the animal alive for about 24 hours thereafter. The eyes are quite small (Fig. 1) and burning operations were unsuccessful, two fishes being killed in attempts to obliterate the eyes in this way. The eyeless fishes were also found to be sensitive to light, and to orient, with some precision, away from it. The reaction time to direct sunlight was, in the one case measured, about 3 seconds.

Even with normal specimens, it was possible to induce weak swimming by illuminating merely the hinder half of the body.

There seems consequently no reason to doubt the occurrence in *Ogilbia* of a true photic sensitivity of the skin—a result of special significance in view of the integumentary photic sensitivity found in *Amblyopsis* (Payne, '07), and of the fact that the blind Cuban brotulid *Lucifuga* (Eigenmann, '09, p. 199) seems probably to be photonegative (although the data are scanty). This type of irritability is rather characteristic of cave vertebrates, and its presence in *Ogilbia* is perhaps susceptible of a significant interpretation. In Eigenmann's view, the blind cave fishes *derive* from types originally photonegative, living in darkness under stones along "coral" reef shores, which survived a process of adaptive adjustment to fresh water and to cave environments conditioned by gradual elevation of the land.[2] It is frequently assumed that special modes of behavior, notably those dependent upon enhanced photic and tactile irritability, represent new developments determined in relation to blindness and to the conditions of cave environments. Hence it is important to recognize that even a manifestation so rare among marine fishes as skin sensitivity to light, is adequately exemplified in a teleost, not cave-inhabiting, but with eyes seemingly degenerate and on other grounds assigned as representative of the ancestral origin of typically adjusted cave forms. The state of pre-adaptation

[2] It may be mentioned that I have several times made search for fishes in cave pools at Bermuda, but have never encountered fishes in them, save where obvious communications led to outside water.

thus indicated is reflected also in connection with tactile irritability (Crozier, '18).

Summary.—Ogilbia verrillii, shore-living brotulid and close relative of blind brotulids of Cuban caves, has relatively small eyes and is decidedly photonegative in its behavior. Its skin is sensitive to light, a condition thus far recognized in but one other marine fish; this is taken to be of significance for the conception of preadaptation.

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